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ABSTRACT

Suggesting that headings provide useful cues for input/output processing, this investigation examined the utility of intact (topic outline format) and embedded (appropriately positioned within text) headings as processing aids with non-narrative text material under conditions of immediate and delayed recall. Passages were selected from biology (ecosystems) and geology (plate tectonics) textbooks. General psychology students (N=95) were randomly assigned to training or no-training groups. Results indicated that input/output training on use of headings was ineffective in comparison with students who employed their "normal" study methods with the headings; it was suggested that this failure to find a facilitative effect of training may have been due to the limited amount of time students had to integrate new strategies with their existing techniques. Results also indicated that students provided with text containing headings performed significantly better than did students whose text did not contain these processing aids. In general, results supported the assumption that the presence of intact and embedded headings facilitated performance with non-narrative text, particularly at long-term delays, suggesting that these devices may be more useful as retrieval aids than as comprehension aids, particularly when students have limited prior knowledge of subject matter. (Author/JN)

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Effects of Individual Differences, Processing Instructions, and Outline and Heading Characteristics on Learning from Introductory Science Text

Section 1: Utilizing Intact and Embedded Headings as Processing Aids with Non-Narrative Text.

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FINAL REPORT

January 1982

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General Summary

A series of experiments were conducted to examine the impact of author-provided and student-generated headings on the recall of 2,500-word excerpts from basic science textbooks. If the students are sensitized to the presence of author-provided embedded headings, the delayed recall is significantly enhanced in comparison to individuals studying text without headings. However, author-provided intact headings (i.e., outlines) did not lead to significant improvements in recall.

Instructing students on using embedded headings to aid in the comprehension, storage, and retrieval of the text information led to even further improvements in delayed recall performance in comparison to groups receiving either no headings or no instructions on using headings. However, limiting instructions to only the inputting or outputting of the text material did not prove to be effective.

Since many texts contain only sparse headings or no headings at all, the impact of students generating their own headings was assessed. This generation activity led to improvements in delayed recall in comparison to either author-provided headings or no headings.

Intermediate between having the students generate their own headings and directly employing author-provided headings is an approach which provides the students with a generalized set of headings (knowledge schema) that can be imposed on a variety of texts. A knowledge schema for scientific theories was created and students were trained in its use as a text processing technique. Two studies indicated that this training led to improved recall

in comparison to students using their normal study methods. In addition text organized according to this schema was recalled better than text organized in a coherent, alternate presentation sequence.

In conclusion, the results of the reported series of experiments suggest that under most conditions author-provided, embedded headings facilitate descriptive text processing. Further, having students generate their own headings or having them impose a general set of categories (knowledge schema) on a body of text appears to result in even more effective text recall. The pragmatic and theoretical implications of these findings are discussed within each section of the report.

This final report consists of descriptions of a series of experiments conducted to examine the role of topic headings (author-provided and student-generated) in text processing. These experiments fulfill the requirements set forth in NIE Grant Number NIE-G-79-0157.

Utilizing Intact and Embedded Headings as
Processing Aids with Non-Narrative Text

Abstract

This study examined the utility of intact (i.e., topic outline format) and embedded (i.e., appropriately positioned within the text) headings as processing aids with non-narrative text. The argument was advanced that headings potentially provide useful cues for both input and output processing but that little empirical evidence exists to either support or refute this proposition. It was further argued that each of the prior studies reviewed were subject to one or more methodological criticisms which may attenuate the generality of the findings. The results of the present study indicated that no advantage accrued to students on the basis of training; however, limitations of this finding are discussed in terms of the amount of training provided and the time available to the students for integrating the new strategies with their existing techniques. The major result of this investigation was that students provided with text containing intact and embedded headings significantly outperformed students whose text did not contain these processing aids. The major benefits were observed at delayed testing; the text-with-headings students recalled approximately 11 percent more information at delayed testing than the text-without-headings students. Implications of these results and future research issues are discussed.

Utilizing Intact and Embedded Headings as Processing Aids with Non-Narrative Text

Headings, whether presented intact (i.e., in topic outline format) or embedded in text, are prevalent in most high school and college textbooks; they are also a highly recommended prelude to writing (e.g., Hodges & Whitten, 1977; pp. 337-347). Headings can provide information about the structure of knowledge in a particular domain and/or the author's communication structure. During input processing, headings potentially provide cues for triggering a student's prior knowledge, and a system for organizing the information for higher order comprehension and storage. During output processing, headings may serve as retrieval cues and as formats for responding.

Even though headings are used extensively by authors, emphasized in study skills courses, and recommended as adjuncts in teaching content (e.g., Thelen, 1976), there has been very little research on their utility as processing aids. Further, the effects of intact and embedded sets of headings have been examined separately in this prior research.

Northrop (Note 1) found that presenting students with an outline before seeing a film had a positive effect on recall. However, with prose material, Christenson and Stordahl (1955) failed to find any facilitating effects for a number of organizational aids including outlines. More recently Proger, Taylor, Mann, Coulson, and Bayuk (1970), testing four types of supplementary material, found that sentence outlines significantly enhanced subsequent test performance only on items included within the outline. In a related experiment Proger, Carter, Mann, Taylor, and Bayuk (1973) found that

presentation of a sentence outline or a paragraph abstract had a greater positive impact on comprehension scores than presentation of a true-false pretest.

Eggen, Kauchak, and Kirk (1978), in an experiment with fourth, fifth, and sixth grade students, found that hierarchical outlines presented in addition to a 1,000-word text significantly improved performance on production and comprehension subtests.

Using hierarchical outlines as pre and post organizers for passages containing logically ordered and scrambled paragraphs, Glynn and DiVesta (1977) found that pre-material outlines significantly facilitated recall of specific reproductive statements, and that post-material outlines, when given with a text containing scrambled paragraphs, enhanced recall performance for productive statements.

Previous research with titles has demonstrated the potential importance of embedded headings in the processing of prose. Using short, narrative passages that were specially constructed to be ambiguous, Bransford and Johnson (1973) demonstrated that the title ("heading") presented before a passage strongly determined the interpretation given to the passage; further, sentences more consonant with a particular interpretation had a higher probability of recall when the subject received the corresponding title. Bransford and Johnson interpreted these results as indicating that appropriate titles can aid the comprehension and recall of prose by providing the reader with effective schemata (plans) for processing the material; this study was later replicated by Schallert (1976). Similar positive results for single headings have been obtained by Anderson, Spiro, and Anderson (1978) and Doktorow, Wittrock, and Marks (1978).

The few prior studies designed to assess the effects of sets of embedded headings have produced equivocal results (e.g., Hites, 1954; Klare, Shuford, & Nichols, 1958; Lee, 1965; Robinson & Hall, 1941). These results are not necessarily surprising given the apparent lack of sensitive dependent measures and diverse methodologies for developing headings and assessing their impact.

As alluded to in the foregoing paragraph, a number of methodological shortcomings are apparent in the studies cited, particularly with respect to ecological validity. Briefly stated, these shortcomings are: (a) the use of nonoptimal dependent measures; i.e., cued exams such as multiple choice or cloze (cf. Carter & Carrier, 1976; Carroll, 1971), (b) the use of short, artificial prose (cf. Rothkopf, 1972), (c) the use of an immediate testing paradigm (cf. Gagne, 1978), (d) lack of training (Robinson & Hall, 1941; Rigney & Munro, Note 2), and (e) examining the effects of intact and embedded headings separately.

The present investigation sought to respond to each of these sources of criticism. The specific objectives of the study were to examine the influence of headings as processing aids and training on the use of headings (both as input and output processing aids) with ecologically-oriented text under conditions of immediate and delayed recall; both intact and embedded headings were utilized in the investigation.

The hypotheses to be addressed by this investigation were:

1. Since the input role of headings may be limited by the prior knowledge of the students, the use of ecologically oriented text might limit the effectiveness of headings on input. Consequently, it was expected that output training would result in better performance than train-

ing for input. Further, any advantages of output training would more likely be observed in the delayed testing condition.

2. The performances of students receiving training on the use of intact and embedded headings as processing strategies were expected to be superior to that of untrained students provided with headings.

3. Since the presence of intact and embedded headings was assumed to be a processing aid, it was expected that the performances of students receiving stimulus passages containing the headings would be superior to the performances of students whose passages did not contain the headings. Further, any advantages of headings as processing aids would more likely be observed in the delayed testing condition.

Method

Participants

Ninety-five students were recruited from general psychology courses and randomly assigned to the four groups. (Five students failed to complete the experiment.) All students received four hours of experimental participation credit and a small fee.

Procedure

The study consisted of four sessions:

Session 1 (120 minutes)

During this session students were randomly assigned to groups; members of each group were directed to designated classrooms and received folders containing practice materials and instructions corresponding to group assignment. Additionally, treatments and administrators were randomly assigned to groups.

The training groups' (groups I/T and O/T) sessions consisted of the students reading the strategy instructions and then applying the technique to a practice passage similar in format to the passages to be encountered during the assessment sessions. Briefly stated, group I/T's strategy was to attend to the embedded headings during input processing and to actively attempt to tie the heading to the information presented in the text; group O/T's strategy was to (sequentially) read the passage, use the topic outline to recall the information in the text, and, finally, to memorize the topic outline (detailed explanations are available in Holley, 1979). Following this study period (20 minutes) the students were tested over the passage using the type of exam (i.e., free recall) to be employed as the dependent measure in the assessment sessions.

The "no-training" groups' (groups C [passages-without-headings] and H [passages-with-headings]) sessions were identical to those of the training groups with the exception that the students' instructions were to apply their "normal" study methods during the study session (see Dansereau, Collins, McDonald, Holley, Garland, Diekhoff, & Evans, 1979; Holley, Dansereau, McDonald, Garland, & Collins, 1979; and Holley & Dansereau, in press, for elaboration of the no-training control procedure).

Session 2 (120 minutes)

Students spent 50 minutes studying a 2400 to 2500-word passage. Two passages were utilized: one extracted from an introductory geology textbook ("Plate Tectonics") and one extracted from an introductory biology textbook ("Ecosystems"). One-half of the students (within each group) received the geology passage and the other one-half received the biology passage; during

session 3 each student received the passage to which s/he was not exposed during session 2. After studying the passage, students spent 18 minutes responding to a free recall exam.

Session 3 (60 minutes)

Students spent 50 minutes studying and taking notes over the "second" passage.

Session 4 (60 minutes)

During this session, which occurred five days after the previous session, students responded to the free recall exam (18 minutes) for the "second" passage. All procedures were identical to those employed in session 2 with the exception that the students also completed a post experiment questionnaire.

Stimulus Material

Passage selection. As previously stated, two prose passages were employed in the study; these passages were selected from introductory textbooks and have been utilized in a number of prose processing experiments (e.g., Collins, Dansereau, Holley, McDonald, & Garland, in press; Dansereau et al, 1979; Holley et al, 1979; Holley & Dansereau, in press; Holley, Dansereau, & Fenker, in press; Dansereau, Holley, Collins, Brooks, & Larson, Note 3). The passages have similar noncontent properties and discuss two separate subject matters (i.e., plate tectonics and ecosystems). While prior content knowledge was controlled via randomization, previous research has indicated that students have limited prior knowledge of the contents in the passages.

Development of headings. Using the author-provided headings as a starting point, five judges who were knowledgeable about each of the content

areas rated the appropriateness of each heading on a nine-point Likert-type scale (1=very inappropriate, 9=very appropriate). Each judge was instructed to suggest alternatives for headings receiving a rating less than seven. The process was then repeated on suggested alternatives until sets of headings meeting the criteria were produced. In order to control for the possibility that the headings might provide information not available in no-heading versions of the text, it was necessary to impose the additional criterion that the information presented in a heading was also available in the section following the heading.

Dependent Measures

The free recall dependent measure required the participants to write down everything remembered about the content of the passage(s) without the aid of experimenter-provided cues. No stipulation was put on the order or organization of the recall.

All of the examinations were coded for blind scoring and were scored by a colleague not associated with the investigation; a random sample of the tests were scored independently by one of the authors to asses inter-rater reliability. Responses were assigned points on the basis of number of accurate "idea units" recalled from the passage; no credit was given for inferential statements.

Analyses

The analytic procedure consisted of a series of discrimant analyses on the free recall measures at immediate and delayed testing. This series represented planned comparisons specifically designed to address the aforementioned hypotheses. Adoption of the discriminant analysis procedure was

based on arguments presented by Harris (1975) and Lana and Lubin (1970) favoring a multivariate approach over a univariate, repeated measures procedure. Specifically, the former procedure avoids the rather sensitive assumption regarding the intraclass correlations underlying the univariate method and also provides readily interpretable weights regarding the relative contributions of the two dependent measures (immediate and delayed free recall) in distinguishing between the groups.

Results

A Pearson product-moment correlation of .87 between the two scorers was judged to represent an adequate standard of interrater reliability.

Means and standard deviations for the free recall measures are reported in Table 1. The discriminant analysis between the two training groups on the free recall exams failed to produce a significant discriminant function, $\chi^2(2) = .79$, $p \leq .67$. This outcome indicated that the training groups could be collapsed for comparison against the no-training group that had received stimulus passages with headings. (See Table 2 for all of the discriminant equations.)

Insert Tables 1 and 2 about here

The discriminant analysis between the collapsed training groups (T) and headings-without-training group (H) also failed to produce a significant discriminant function, $\chi^2(2) = 0.00$, $p \leq 1.00$. This result suggested that training on the use of headings provided no improvement over simply incorporating those cuing devices within the text. Consequently, groups

T and H were collapsed for comparison against the control group.

The equation contrasting group T/H against group C was significant, $\chi^2(2) = 6.70$, $p \leq .04$; the performance of the former group was superior to that of the latter group. The pattern of loadings suggested that the performance advantage attained by providing students with text containing intact and embedded headings was attributable primarily to increased recall of information in the delayed testing condition. The relative importance of the two testing conditions to the discriminant function was approximately 4:1 in favor of the delayed test. Additionally, students receiving stimulus passages containing intact and embedded headings recalled approximately 11 percent more information at immediate testing and 44 percent more information at delayed testing than students whose passages did not contain these processing aids.

Results from the post experiment questionnaire indicated that students in group C apparently did not believe that the absence of the headings disrupted either their studying or test-taking. In this regard, it is important to point out that students would not be completely unaccustomed to encountering "no-headings" material of this length (2400 to 2500 words) in the course of their normal text processing activities. These data suggest that the superior performance of the students whose passages contained headings is not simply attributable to differences in "novelty" between the experimental manipulations.

Students in all groups reported approximately equivalent (and negligible) prior content knowledge of the passages, as well as experimenter influence

upon their performances. From the perspective of the experimental paradigm employed, it is important to note that groups C and H were exposed to identical experimental influences; i.e., participated in all of the experimental sessions as a single group.

The questionnaire responses of students in groups C and H (groups O/T and I/T's responses may have been influenced by the treatment) indicated that the college student makes substantial use of headings and outlines as study and test-taking devices. Consequently, training students on a new procedure for using the intact and embedded headings may have interfered with the students' present strategies leading to no improvement or even an amelioration in performance. Similar interference effects have been observed in the training of learning strategies (e.g., Holley et al, 1979; Pask, 1975). This "problem" may have been particularly acute in the present investigation due to the small amount of training given and the limited time the student had for integrating the "new" technique with the "old" strategy.

Discussion

This investigation examined the utility of intact and embedded headings as processing aids with non-narrative text. The present investigation sought to respond to each of the sources of criticism that were cited in the review of previous research. The specific objectives of the study were to examine the influence of headings as processing aids and training on the use of headings (both as input and output processing aids) with ecologically oriented text under conditions of immediate and delayed recall; both intact and embedded headings were employed in the investigation.

The results indicated that input and output training on the use of headings was ineffective in comparison with students that employed their "normal" study methods with the headings. However, this failure to find a facilitative effect of training should be interpreted cautiously since the negative findings may have been due to the limited amount of time the students had to integrate the new strategies with their existing techniques. Previous research on learning strategies training has indicated that amount of training and time for integration may be important variables in such contexts (e.g., Dansereau, 1978). Additionally, the training methods employed in the present study should be regarded more as providing the students with an instructional set for the input or output use of the headings rather than as providing the students with an intensive training program.

The results also indicated that students provided with text containing headings performed significantly better than students whose text did not contain these processing aids. The principal difference between the groups occurred in the delayed recall condition; students in the with-headings groups recalled approximately 11 percent more information at immediate recall and 44 percent more information at delayed recall than students in the without-headings group.

In general, the results of this study support the assumption that the presence of intact and embedded headings facilitate performance with non-narrative text, particularly at long-term delays. This outcome tentatively suggests that these devices may be more useful as retrieval aids than as comprehension aids, particularly when students have limited prior knowledge

of the subject matter. This interpretation may explain why some of the previous investigations exploring the utility of headings as comprehension aids with immediate testing conditions failed to find facilitative effects (e.g., Klare, Shuford, & Nichols, 1958; Robinson & Hall, 1941).

The pragmatic inplications of the present study appear to be rather straightforward. Texts should be constructed with intact and embedded headings and students should make extensive use of these devices for studying and test-taking. However, the present investigation also leaves a number of unanswered questions. For example: Can better criteria be established for defining the properties of headings? Is there an optimum number of headings for a given passage length? Do the headings need to be arranged hierarchically? Is training beneficial for certain students and not others? What is the optimum training procedure? Are there meaningful relationships between individual differences and manipulations involving headings? Obviously this does not represent an exhaustive list of potential research questions. What it does represent is a sample of the type of issues for which the present investigation may serve as a springboard.

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Table 1

Means and Standard Deviations on

the Free Recall Measures[a]

Group[b]		Free Recall Exam	
		Immediate	Delayed
Control (C) (n=23)	$\bar{x}$	40.58	24.90
	sd	14.13	14.07
Headings (H) (n=24)	$\bar{x}$	46.31	35.42
	sd	13.49	19.44
Input (I/T) Training (n=22)	$\bar{x}$	45.82	38.23
	sd	14.57	21.54
Output (O/T) Training (n=21)	$\bar{x}$	42.87	33.84
	sd	20.84	12.04

[a]Scores are reported in percentages of maximum possible score.

[b]See text for elaboration.

Table 2

Discriminant Equations Developed

for the Free Recall Analyses

Comparison[a]	Free Recall Exam		$p \leq$
	Immediate	Delayed	
O/T vs I/T	1.45	2.68	.67
T vs H	3.81	-1.72	1.00
T/H vs C	1.07	3.79	.04

[a] O/T vs I/T: Output training compared to input training.

T vs H: The collapsed training groups compared to the headings-without-training group.

T/H vs C: The collapsed headings-without training group and headings-with-training groups compared to the no-headings-no-training group (i.e., presence of headings compared to absence of headings).